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REPORT [redacted] 50X1-HUM

CD NO.

COUNTRY	USSR	DATE OF INFORMATION	1949
SUBJECT	Scientific - Physics, thermodynamics, ideology		
HOW PUBLISHED	Monthly periodical	DATE DIST.	14 Nov 1950
WHERE PUBLISHED	Moscow	NO. OF PAGES	3
DATE PUBLISHED	Oct 1949		
LANGUAGE	Russian	SUPPLEMENT TO REPORT NO.	

50X1-HUM

THIS IS UNEVALUATED INFORMATION

SOURCE Uspekhi Fizicheskikh Nauk, Vol XXXIX, No 2, 1949, pp 299-306.

A FAULTY INTERPRETATION OF THE SECOND LAW OF THERMODYNAMICS

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/The following is a digest of Kuznetsov's criticism of N. V. Kashin's book, Physics Course for Teachers' Institutes, Vol I (Kurs Fiziki dlya Uchitel'skikh Institutov, tom I), Uchpedgiz, Moscow, 1948. The criticism starts after a preliminary denunciation of vitalists and idealists./

The laws of thermodynamics have long been the subject of obdurate fault-finding and antiscientific falsification on the part of idealists. First were the vitalists, who believed that the living organism was not subject to the law of conservation and transformation of energy. By direct experiments, however, particularly those of K. A. Timiryazev, this viewpoint was proved false and so the vitalists changed tactics, interpreting the law for themselves. Lenin himself then delivered an annihilating criticism of the energetics of V. Ostwald, who tried to deny the reality of matter and the objective existence of the atom. More disturbing to the author /Kuznetsov/, however, is Clausius's theory of the heat death of the universe. Clausius is to be commended for his work in the formulation of entropy, but his theory that there will be an end of the world, which implies a beginning by the will of a supreme creator, is to be branded as antiscientific and popish.

The theory of heat death postulates that, although no energy can be lost, heat energy will eventually become so dispersed that it will lessen in quality and eventually lose the ability to become transformed into other forms of energy. The result is that the universe will come to an end. This theory is refuted indirectly in F. Engels's Dialectics of Nature. Engels held that the law of conservation of energy was an expression of the law of the indestructibility of motion. According to Engels, movement must have an unlimited ability for qualitative change. If matter lacks the unlimited capacity to produce changes back from heat energy to motion or other forms of energy, then it has suffered a definite loss of motion, just as motion which has lost the capacity to be converted into its various indigenous forms is partially destroyed. Thus, the theory of heat death stands in direct contradiction to the first law of thermodynamics.

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Kashin affirmed as general truths the equality and applicability of the two laws of thermodynamics. However, he considered the second law to be applicable, just as the first law, to all phenomena of nature, infinitely large or infinitesimally small, with neither exceptions nor limitations, thus vitiating the contents of the first law by unconditionally expanding the second. Furthermore, in Chapter XI, Kashin represented the first law as of purely quantitative conservation of energy. In Chapter XII he opposed Engels's view of the qualitative indestructibility of motion. Citing the example of a glass of hot water poured into a vessel of cold water, with subsequent qualitative loss of energy -- that is, a loss of further capacity for conversion into other forms of energy on the part of the heat energy involved on account of its dispersion -- Kashin reached the general teleological conclusion that we are surrounded on all sides by processes of degradation of energy, as a result of friction, radiation, and heat conduction. This viewpoint of Kashin's is to be criticized because he considered the process of degradation of energy as the most characteristic feature of natural processes and over-emphasized the second law of thermodynamics. Finally, Kashin, observing that an increase in entropy in a system indicated dissipation or degradation of heat energy, predicted that a general increase in entropy is probable. Kashin's conclusions in effect restate the theory of the heat death of the universe. His viewpoint is refuted as follows.

The complete scientific worthlessness of attempts to assert that there might be tendencies existing in nature toward dissipation or degradation of energy as the essence of the second law of thermodynamics has already been revealed. It has been established that these assertions in no way express the true contents of the second law. (On this subject see M. Planck's Thermodynamics, 1925 and his Introduction to Theoretical Physics, Part 5, Theory of Heat, 1935.) The second law of thermodynamics characterizes the irreversibility of natural processes and determines the predominant, on the average, direction of their course in the case of a system of ordinary macroscopic scale containing a sufficiently large quantity of molecules. Consequently, the second law of thermodynamics, asserting the impossibility of spontaneous decrease of entropy in adiabatic closed systems, is inapplicable in the field of small combinations of microscopic particles. A series of very important experimental facts such as Brownian movement and surface fluctuations testify directly to this. The peculiarities in the behavior of matter at extremely low temperatures leads to the conclusion that also under these conditions whole series of very important concepts in thermodynamics must be modified.

All this points beyond any doubt to the inadmissibility of one's unconditionally extending the application of the second law of thermodynamics from limited thermodynamic systems extant in our ordinary terrestial conditions to the whole infinite universe with all its infinite diversity of conditions for the existence of material bodies.

Meanwhile, there exist no limitations on the action of the law of conservation and transformation of energy. The findings of contemporary physics have not only affirmed its accuracy both for the infinitely great and the infinitesimally small, but also introduced new evidence of never-dying capacity of energy for ever new transformations. An example of this is the ability of the energy of heat radiation to be converted into other forms, such as the energy of electric charges and the energy of excitation of atoms. Further, the work of the Soviet astrophysicist V. Ambartsumyan demonstrates that new galaxies are still growing and that concentrated macroscopic bodies can be generated from scattered interstellar matter. All this bears witness to the fact that the capacity of matter for new birth and for eternal transformation from one form to another never ceases and that the heat death of the universe is an antiscientific fabrication of idealists.

Other less important errors in Kashin's book can be enumerated, such as the low theoretical level of his discussions on the philosophical problems of physics, his misunderstanding of the regular interrelations between phenomena, and his insufficient emphasis on the role of empiricism in scientific advances. It is hard to explain why such a book was allowed to appear by the Ministry of Education RSFSR.

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